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# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



## **THESIS**

**ANALYSIS AND EVALUATION OF HIGH SPEED  
FERRIES FOR USE AS LOGISTIC SUPPORT VESSELS IN  
SUPPORT OF JOINT LOGISTICS OVER-THE-SHORE**

by

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March 2002

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LOGISTIC SUPPORT VESSELS IN SUPPORT OF JOINT LOGISTICS OVER-  
THE-SHORE**

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Submitted in partial fulfillment of the  
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## **ABSTRACT**

Recent developments in High Speed Ferry (HSF) technologies, and the successful use of the HMAS Jervis Bay as a Logistic Support Vessel (LSV) by the Royal Australian Navy, introduced the potential for HSFs to serve as LSVs in support of Joint Logistics Over-the-Shore (JLOTS). This thesis analyzes the opportunities available to the Department of Defense (DoD) to utilize HSFs as LSVs in support of JLOTS.

In conducting the analysis, this thesis considers the observations and lessons learned from the Australian use of the HMAS Jervis Bay, previous testing of an Incat 91-meter HSF by the Naval Surface Warfare Center Carderock Division, the initiatives of the current Joint Venture (HSV-X1) lease, current JLOTS doctrine, and the principles of Joint Vision 2010 and 2020.

Our research concludes that HSFs possess certain advantages over current LSVs in the areas of speed, range, and payload. It is these advantages that give the HSFs the ability to perform both modern day and future JLOTS operations with greater flexibility than current LSVs. We suggest that by using HSFs as LSVs during JLOTS operations, DoD could employ a technically advanced and highly capable platform that could augment or replace current LSVs.



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## **LIST OF ACRONYMS**

AO	Area of Operations
ARG	Amphibious Ready Group
CCDoTT	Center for the Commercial Deployment of Transportation Technologies
COLDS	Cargo Offload and Discharge System
COMPHIBRON	Commander, Amphibious Readiness Squadron
COTS	Commercial Off-the-Shelf
DoD	Department of Defense
ELCAS	Elevated Causeway System
HLPS	Heavy Lift Prepositioned Ship
HSF	High Speed Ferry
HSS	High Speed Shipping
JLOTS	Joint Logistics Over-the-Shore
JV 2010	Joint Vision 2010
JV 2020	Joint Vision 2020
LCAC	Landing Craft Air Cushioned
LCM	Landing Craft Mechanized
LCU	Landing Craft Utility
LOTS	Logistics Over-the-Shore
LSV	Logistic Support Vessel
MSC	Military Sealift Command
NM	Nautical Mile
NSWC	Naval Surface Warfare Center
RO/RO	Roll-On/Roll-Off
RRDF	Roll-On/Roll-Off Discharge Facility
RRF	Ready Reserve Force
SES	Surface Effect Ship
SS	Sea State



STONS	Short Tons
SWATH	Small Waterplane-Area Twin Hull
VERTREP	Vertical Replenishment

## **I. INTRODUCTION**

High Speed Shipping (HSS) is emerging as a major trend in the shipping world. Europe, Australia and Asia are leaders in its use, but the United States, with the cooperation of foreign ship builders, may be a customer for this technology as well. (Reininger, 2001) The chairman of Stena Line had the following to say about HSS:

Our technical achievements [with the HSS] will revolutionize ferry traffic worldwide and the commercial importance of this breakthrough can be likened to the changeover in the aviation industry from propeller driven aircraft to jet engines. (Blunden, 1997)

The recent increase in the use of HSS technology coupled with the overall growth of the HSS industry, has led to increased interest from both U.S firms and the Department of Defense (DoD) in the potential applications and uses of HSS, particularly in the area of High Speed Ferries (HSFs).

The use of the 86-meter Incat (HMAS Jervis Bay) by the Royal Australian Navy demonstrated the viability of commercial HSFs to serve as an advanced-capability military Logistic Support Vessel (LSV). Additionally, the evaluation of the 91-meter Incat HSF by the Naval Surface Warfare Center (NSWC) Carderock Division and the current Department of Defense (DoD) lease of the Joint Venture (HSV-X1) will provide insights on the potential of HSFs to perform a variety of U.S. military functions. These projects contain the information required to analyze the potential for HSFs to provide superior speed, range, payload, and maneuverability over current LSVs utilized by DoD. The Incat evaluations also opened new avenues of research by DoD into potential military applications of HSFs.

Perhaps the greatest potential for HSFs to serve as LSVs is in support of Joint Logistics Over-the-Shore (JLOTS), where the predicted capabilities of HSFs would be particularly well suited in terms of providing distinct advantages (outlined above) over current LSV platforms. Additionally, Joint Vision 2020 emphasizes the need to grasp new technologies in support of the Focused Logistics and Dominant Maneuver concepts that drive future military operations. HSFs have demonstrated the potential to serve as a

technologically advanced platform that could satisfy these concepts, as well as enhance and support the operational concepts outlined in JLOTS.

## **A. PURPOSE**

This research analyzes the opportunities available to the DoD to utilize HSFs in support of JLOTS. Recent developments in HSF technologies, and the successful use of the HMAS Jervis Bay as a LSV by the Royal Australian Navy, introduced the potential military applications of HSFs as a LSV in support of JLOTS. This research will consider the observations and lessons learned from the Australian use of the HMAS Jervis Bay, previous testing of an Incat 91-meter HSF by the NSW Carderock Division, the Joint Venture (HSV-X1) lease, current JLOTS doctrine, and the principles of Joint Vision 2010 and 2020. The goal of this research is to determine if DoD can utilize HSFs as viable LSVs in support of the current JLOTS initiative, while maintaining the visions of Focused Logistics and Dominant Maneuver outlined in Joint Vision 2010 and 2020.

### **1. Primary Research Question**

Do current HSFs provide significant advances in speed, range, payload, and flexibility over the current LSVs used to support JLOTS operations?

### **2. Secondary Research Questions**

- Can HSFs, serving as LSVs in support of JLOTS, satisfy the operational concepts of Focused Logistics and Dominant Maneuver outlined in Joint Visions 2010 and 2020?
- How could utilization of HSFs as LSVs during various types of JLOTS operations, such as delivering equipment, personnel and supplies to both developed and undeveloped ports and beaches, best meet DoD requirements?
- What significant technological advantages do HSFs possess in terms of speed, range, payload, and flexibility over the current LSVs used to support JLOTS operations?

## **B. METHODOLOGY**

We will use current published documentation and literature to provide the basis for answering the research questions in paragraph B. In addition, we will conduct personal interviews with subject matter experts to further clarify and expand on information extracted from published documentation and literature. The personal interviews will also allow us to identify limitations to the study and clarify basic assumptions used in our analysis.

The methodology used in this thesis will consist of the following steps:

- Conduct literature search of the following sources to obtain information relevant to the capabilities and limitations of existing HSF platforms and specific requirements to support JLOTS:
  - pertinent transportation and logistics books and magazine articles
  - Department of Defense and Navy publications
  - CD-ROM systems
  - other library information
- Conduct personal interviews with various personnel in DoD, commercial HSF industry, and the Australian Defense Department to obtain information relevant to the capabilities and limitations of existing HSF platforms and specific requirements to support JLOTS

### **C. THESIS ORGANIZATION**

Chapter II provides the background data that lays the foundation for this research, and will open with a discussion of current trends in HSF technology, to include both commercial trends and military studies and evaluations. This will be followed by a brief discussion of the Focused Logistics and Dominant Maneuver tenets of Joint Vision 2020, and how HSFs can satisfy these tenets. We then provide an overview of JLOTS operations and equipment and the current LSVs used to support JLOTS operations, and conclude with a chapter summary.

Chapter III focuses on analyzing how current HSFs can be utilized to support JLOTS operations, to include the distinct advantages HSFs offer over current LSVs. Additional insight explains how HSFs can be utilized to advance and improve existing operational doctrine outlined in JLOTS. A chapter summary highlights the important concepts used for the analysis in Chapter III.

Chapter IV is a summary of the research and analysis and provides final conclusions and recommendations to the study. It also offers additional areas for further research into the potential applications of HSFs by DoD.

### **D. SCOPE AND LIMITATIONS**

This research analyzes current HSF technology; the lessons learned from the use of the HMAS Jervis Bay by the Royal Australian Navy, and current DoD initiatives to determine if HSFs satisfy the requirements outlined in current DoD doctrine. In order to

conduct the analysis in Chapter III, assumptions on the capabilities and limitations of current HSF platforms are required. These assumptions will relate to physical abilities of current commercial crafts and their ability to meet military requirements. The assumptions are based on interviews and data obtained from commercial HSF companies and members of the DoD currently involved in HSF initiatives. These assumptions will be a limiting factor in the accuracy of the analysis. Although not tested, these assumptions are based on the most current information available.

## **II. BACKGROUND**

Prior to conducting our analysis in Chapter III, it is necessary to provide some relevant background information pertaining to High Speed Ferries (HSFs) and Joint Logistics Over-the Shore (JLOTS). The purpose of this background information is to:

- Describe the principal characteristics of modern day HSFs and discuss the latest commercial trends in HSF technology
- Provide an overview of current DoD initiatives that are exploring the potential use of HSFs by DoD
- Provide an overview of JLOTS operations and equipment, including the importance of JLOTS in today's military environment, the characteristics of relevant Logistic Support Vessels (LSVs) used to support JLOTS, and limitations of current JLOTS equipment and LSVs
- Discuss the requirements of Joint Visions 2010 and 2020 (JV 2010 and 2020) and provide some insight on how HSFs can satisfy these requirements

### **A. CURRENT HIGH SPEED FERRY TECHNOLOGIES**

The commercial HSF industry in the past ten years has seen numerous improvements in technology. To understand these changes, a short history of the industry is provided to become familiar with the evolution of the HSF. In reviewing the current technology, we limit our research to HSF designs by two companies Incat and Austal of Australia. The reason for this limitation is both companies have signed agreements with U.S. firms; and consequently these firms provide the best opportunity for use by DoD due to the limitations of current procurement regulations. The industry has also moved into providing a military use for this technology. Also, an overview of the operations of the HMAS JERVIS BAY allows insight into how this technology assisted the Royal Australian Navy during both real world and training exercises. The DoD has also entered into the realm of HSF technology by conducting testing of a commercial HSF while in transit to a customer. This testing was to determine the operational capabilities of HSF vessels.

## **1. Commercial Trends in High Speed Ferry Construction**

### ***a. High Speed Shipping Defined***

The technical innovations revolving around HSS began in the 50's and the technical advances continue today. To understand the development of the industry, we will define HSS. Although there is no current standard definition, we will use the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) definition. CCDoTT defines HSS as vessels with the following characteristics (Nash, 1999):

- Unrefueled ranges exceeding 3,000 nautical miles
- Payloads above 4,500 tons
- Minimum cruising speed of 35 knots

While this definition is for military applications and there are currently no vessels built that meet all these criteria, our research will use the 35-knot cruising speed as the key criteria that separate HSS from standard sealift vessels.

### ***b. History: 1956-1959***

The HSS industry began in 1956 with the introduction of a vessel that ran between Sicily and the Italian mainland. This ferry was capable of 25 knots and carried 72 people. While this ferry, built in Italy, did not meet the speed criteria, it was the first step towards fulfilling the 35-knot criteria. The Italians continued innovation in the hydrofoil design. By the end of the 50's, they had developed vessels that could carry 140 people at speeds of 32 knots. (Blunden, 1997)

### ***c. History: 1960-1969***

The sixties were still dominated by the Italians in hydrofoil design, but by the end of the decade, five countries were now developing vessels and production increased ten fold. There was another important break through in this decade. The United Kingdom developed the first Surface Effect Ship (SES). This innovation led to a ferry that met the speed criteria. It traveled at 65 knots and carried 254 passengers along with 30 cars. This SES design on a larger scale is still used today in the English Channel. (Blunden, 1997)

***d. History: 1970-1979***

While the hydrofoil still remained the dominant design, there were now seven countries building vessels of different designs. One of these, the Westmaran 86 developed by Norway, is the model for the current design trend. It was a monohaul design with a tunnel punched through the center, described by the HSS industry as an asymmetric catamaran.

This decade also included the United States entrance into the market, with Boeing Marine developing a hydrofoil that delivered passengers at speeds of 42 knots. This design set the standard for ride quality that is used by builders today. (Blunden, 1997)

***e. History: 1980-1989***

The introduction of the symmetric catamaran in the 80's was the springboard to today's HSS industry. This switch to the symmetric catamaran was due to the technological advances in aluminum shipbuilding. Aluminum provided a lighter building material required for the symmetric design. The early 80's still saw Norway as the HSS market leader, but by the middle of the 80's Australia became the industry leader and still is today. The technology of HSS designs by the end of the 80's had vessels that could carry 449 passengers and travel in excess of 35 knots. The catamaran is the design of choice by new customers. (Blunden, 1997)

***f. History: 1990-Present***

The industry has changed over the last 45 years, but some of the same designs built in the 50's are still in use. The technology for the most part has remained in the catamaran design, but larger and faster vessels enter the market yearly. The major shift in the industry is from passenger ferries to passenger and car ferries. The improvements of the propulsion systems have allowed for larger vessels carrying heavier loads. The industry today is still dominated by the Australian's, but Norway and Japan also have claim to the manufacturing base. (Blunden, 1997) However, U.S. shipbuilders have signed agreements with the two HSF industry giants, Incat and Austal, of Australia. These recent agreements will propel the U.S. shipbuilding industry into the HSS market. (Reininger, 2001)



***g. Propulsion and Hull Designs***

Advances in engines and propulsion types have allowed the speed and capacity of the vessels to increase. The introduction of water jet propulsion in the 80's as a viable drive system is one reason why the vessels are able to attain such high speeds. Traditional propellers lose efficiency and cavitate at high speeds. Water jets do not have these characteristics and by design require less power than standard propeller driven vessels. Water jets also eliminate the need for rudders and appendages, eliminating the drag found in propeller driven vessels. (AIMU, 2001)

A standard water jet consists of an engine that drives a set of reduction gears. The reduction gear turns the shaft that is attached to the pump unit. The pump unit is an impeller that directs water through the inlet duct and uses the high pressure water as the propulsion for the vessel. The water jets turn independently to allow the vessel to maneuver, and reversing buckets re-direct the water forward to allow for reversing direction. The ability of the water jets to act independently provides the vessel outstanding maneuverability. The market for larger vessels is also driving the water jet industry to create larger and more efficient jet drive systems.

Due to the large size of the vessels, high horsepower engines are required to propel the craft. In today's HSS vessels, fuel economy is not a benefit. Today's engine designs focus on the power-to-weight ratio. Traditional medium and high-speed diesels are the choice of power for the majority of the industry. These engines are turbo charged and provide a better fuel economy than the other alternative of gas turbines.

Gas turbines provide customers with a lower power-to-weight ratio. This allows the vessel to reduce weight and increase horsepower, which translates into faster speeds. However, the increase in performance and higher power-to-weight ratio leads to poor fuel economy. (AIMU, 2001) The selection of engines and water jets are important to performance, but hull design is the most critical design aspect.

In conducting our research, we have limited the scope to looking at the technology of two different hull designs. Although there are other designs available, these two are the most promising for development in the U.S. We selected two variants of the catamaran hull: the wave-piercing catamaran, developed by Incat of Australia, and

the combination small waterplane-area twin hull (SWATH) catamaran, developed by Austal of Australia.

Incat of Australia designed the wave-piercing catamaran, a displacement vessel with two slender hulls. This design results in a vessel that provides a large amount of deck space for storage of vehicles and cargo. (AIMU, 2001) The two catamaran hulls extend at the bow and operate below the waterline. This allows the vessel to cut through waves rather than riding up and over them, thus avoiding pitching motion. To prevent the hull from slamming in heavy seas and to provide reserve buoyancy, the bow arrangement includes a centerline v-section that rides above the waterline. Further stability is provided by a retractable T-foil mounted in the v-section and stern trim tabs. (Koenig, 2001)

Austal of Australia, designed the SWATH catamaran. It uses design features of a conventional catamaran and technology of SWATH vessels. A SWATH vessel has two submarine-like lower hulls completely submerged below the water and connected to the hull by vertical struts. This design eliminates the forces of waves because the buoyancy of the vessel is below the wave forces at the surface. Although a stable platform, the trade off is speed and/or payload capabilities. (SWATH Int., 1997) Austal solves the payload and speed trade offs by incorporating the SWATH technology forward and the conventional catamaran design aft. The forward SWATH allows for resistance to pitching in seas, while the aft catamaran design provides for the weight capacity normally lost in a full SWATH vessel. (Koenig, 2001) To increase stability, Austal developed an Ocean Leveller stabilizing system. This system is an automatic, electronically controlled and hydraulically operated motion-dampening system. (CMST, 1996)

#### ***h. Design Profiles***

The following section provides an overview of what products each company has available or its product plans for the near future. Incat and Austal have numerous products; our focus was on current platforms that have possible military applications. Information on levels of performance is not the same for each company, so we will highlight all the available statistics.

Incat has passenger and passenger/vehicle vessels that range from 43 meters to 98 meters in length. They vary in capacity, but all have operating speeds equal to or above 35 knots. We will use this as the benchmark for the description and capabilities for high speed ferries. Incat has produced the following vessels (Incat, 2000):

- **86-meter Wave Piercing Catamaran**

Passengers: 867                  Vehicles: 143 cars, 18 small trucks, 4 buses

Engines: (4) 10,000 HP Diesel Engines

Propulsion: Water Jet      Deadweight Load: 415 Tons

Speed: 35 knots                      Distance: 1000 NM

**Military Payload:** 500 combat troops and equipment.

- **Evolution 10B 98-meter Wave Piercing Catamaran**

Passengers: 900                      Vehicles: 260 cars or 26 freight trailers with  
52 TEUs and 80 cars

Engines: (4) 7080KW Diesel Engines

Propulsion: Water Jet      Deadweight Load: 750 Tons

Speed: 35 knots                      Distance: 1000 NM with 600 tons of cargo

- **Revolution 120-meter Wave Piercing Catamaran (under construction)**

Passengers: 1200                      Vehicles: 460 cars or 45 freight trailers with  
90 TEUs and 20 cars

Engines: (4) 9000KW Diesel Engines

Propulsion: Water Jet      Deadweight Load: 1100 Tons

Speed: 40 knots Distance: not available

The distance the ferries can travel varies with the amount of cargo versus fuel load as described in Table 2-1 below. The 98-meter vessel, at 35 knots, can carry 720 tons of cargo 200NM but ranges of 3000NM can be achieved by limiting cargo to 270 tons. The numbers for cargo reflect crew, cargo, water, etc. (Guy Doyle, 2001).

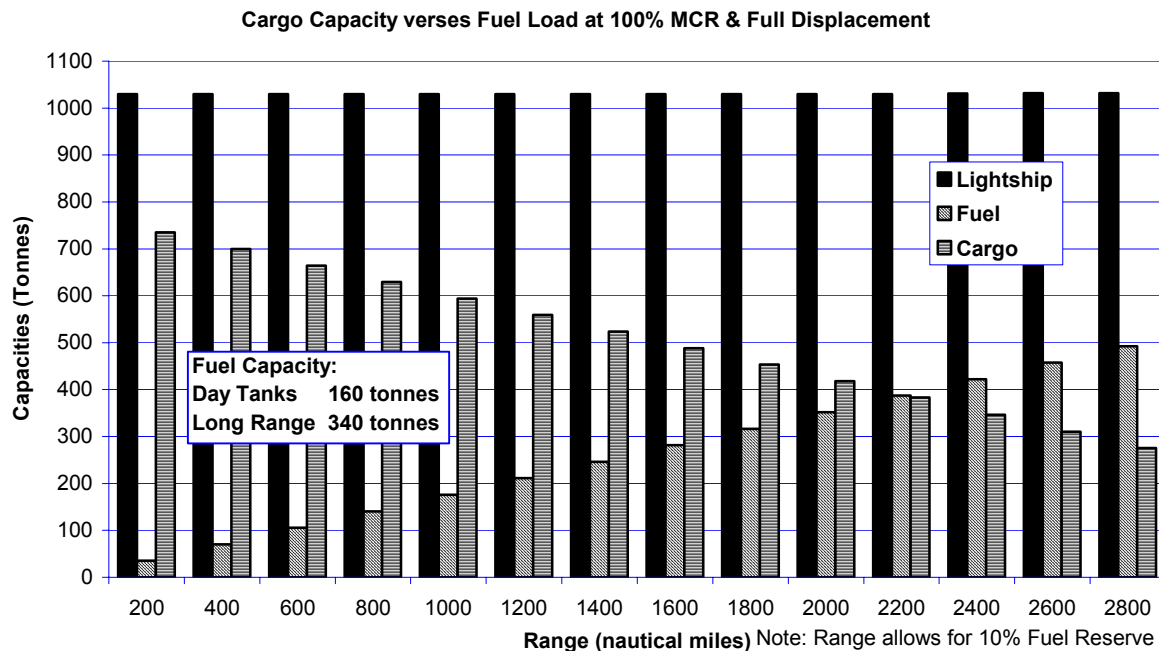


Table 2.1. Cargo Capability vs. Fuel Load at 100% MCR & Full Displacement  
(From: Lowrie, 2001).

The following compares vessel length, payload capacity, speed, and range between current and future Austal and Incat vessels (Incat and Austal, 2000):

- **Auto Express 86 meters**  
 Passengers: 800-1040      Vehicles: 200 cars or 10 buses and 125 cars  
 Engines: Diesel or Gas Turbine  
 Propulsion: Water Jet      Deadweight Load: 400-500 tons  
 Speed: 40-50 knots      Distance: not available
- **Auto Express 92-meter**  
 Passengers: 1050      Vehicles: 188 cars or 4 buses and 150 cars  
 Engines: Diesel or Gas Turbine  
 Propulsion: Water Jet      Deadweight Load: not available  
 Speed: 40 knots      Distance: not available
- **Austal Ro-Con Express (designed no current construction)**  
 Passengers: N/A      Cargo: 80-140 TEUs  
 Engines: Diesel or Gas Turbine  
 Propulsion: Water Jet      Deadweight Load: not available

Speed: 30-45 knots                      Distance: 300-800 NM

- **Austal Ro-Ron Express (designed no current construction)**

Passengers: N/A                      Cargo: 30-40 Trucks (38 ton)

Engines: Diesel or Gas Turbine

Propulsion: Water Jet                      Deadweight Load: not available

Speed: 30-45 knots                      Distance: 300-800 NM

- **Theater Logistic Vessel 101 meters/125 meters (military application, no current construction)**

Passengers: 951/1700                      Cargo: Trucks 4/4

HMMVs 100/114

Helicopters 12/14

Engines: Diesel or Gas Turbine

Propulsion: Water Jet                      Deadweight Load: not available

Speed: 35-45 knots                      Distance: not available

Austal currently has one vessel used for military applications. The III Marine Expeditionary Force leased a 101-meter vessel for a two-month trial period in July 2001. This vessel provided transportation to and from exercises in both Japan and Guam.

## **2. Royal Australian Navy HMAS JERVIS BAY Lease**

Incat of Australia designed and built the HMAS JERVIS BAY. Their design is known as the wave-piercing catamaran, as described previously. The HMAS JERVIS BAY is a commercial design; the only military specifications were the paint scheme and strengthening of the lower decks. Due to the highly automated pilothouse and unmanned engineering space, a crew of 25 personnel operates the HMAS JERVIS BAY and is responsible for its loading. The Royal Australian Navy signed a two-year lease to fulfill a shortfall in their logistic capability due to repair of other assets.

### ***a. East Timor Operations***

HMAS JERVIS BAY left Darwin, Australia on 20 September 1999 bound for the port of Dili in East Timor as part of the International Forces in East Timor (INTERFET). Their tasking was to deliver supplies and troops to the port in Dili. A total of 572 soldiers, with their gear, marched onboard and departed Darwin harbor. In less

than 12 hours, the ship traveled 430 nautical miles at speeds in excess of 40 knots. This was the first real world military operation conducted by what the commercial shipping industry calls a fast ferry. (Hunt, 1999) During the September 1999 – September 2000 period, HMAS JERVIS BAY traveled the Darwin to Dili route 74 times. She carried supplies, troops, armored personnel carriers, light armored vehicles, trucks, refrigerated containers and cargo containers. (Polson, 2000)

The ability to carry troops and cargo was not the JERVIS BAY's only contribution to INTERFET operations. The versatility of the vessel was tested in November when they were tasked to transfer 549 East Timorese from Dili to Suai. These people were displaced from West Timor because of the hostilities. The loading of the passengers and their belongings was a simple process in Dili: however, Suai had no wharf facilities to offload the passengers. To overcome this obstacle, the Royal Australian Navy used the HMAS BALIKPAPAN, one of its landing crafts, to facilitate the transfer. (Williams, 1999)

This operation would be the first of its kind. The JERVIS BAY lowered her stern ramp and berthed against the BALIKPAPAN's bow ramp. A gangway placed between the two vessels facilitated the transfer of the passengers and their belongings. The BALIKPAPAN conducted two trips to facilitate the transfer of the 549 Timorese. The operation only took four hours, which is an accomplishment since neither vessel had ever participated in this type of operation. (Williams, 1999)

***b. Tarawa Amphibious Ready Group (ARG) and HMAS JERVIS BAY Interoperability Exercise***

In September 2000, the TARAWA ARG conducted a two-phase exercise with the JERVIS BAY to determine potential U.S. applications associated with the 86-meter wave-piercing catamaran. The first phase of the exercise was the use of the JERVIS BAY for insertion of a Marine Recon Team and SEAL squad at two locations to conduct surveillance and reconnaissance missions at four different sites. The JERVIS BAY loaded zodiacs and personnel while at sea from the ARG. They transited 430 nautical miles to the first insertion point and offloaded the first two teams. The ship then transited another 57 nautical miles to the second insertion point and offloaded the second two teams. The JERVIS BAY loitered in the vicinity of this point until the second two

teams completed their mission and were loaded back onboard. It then transited back to the first insertion point to recover the first team. The entire mission covered 589 nautical miles and lasted 17 hours while the TARAWA ARG was able to remain 200 nautical miles east of the operation. (COMPHIBRON-5, 2000)

The second phase of the exercise demonstrated the loading, unloading and gripping of U.S. vehicles, embarking troops, and the stability of the vehicles underway. The MEU loaded 10 HMMWVs and 50 passengers onto a barge and then drove them onto the JERVIS BAY via the stern ramp. The vehicles were loaded at an average speed of one every three minutes and gripped down. Upon completion of securing the vehicles, a two-hour underway demonstration was completed. Upon completion the MEU Embark Officer and PHIBRON Combat Cargo Officer concluded that as configured the JERVIS BAY could load 50 HMMWVs and six 5 Ton trucks. (COMPHIBRON-5, 2000)

### **3. Naval Surface Warfare Center Carderock High Speed Ferry Study**

In May 1998, Naval Surface Warfare Center (NSWC) Carderock Division conducted testing of the 91-meter INCAT 046 while in transit from Hobart, Tasmania, Australia to Yarmouth, Nova Scotia, Canada. This testing was sponsored by the United States Transportation Command, the Maritime Administration, and the United States Army to demonstrate high-speed sealift technologies. The majority of the testing focused on fuel consumption and sea keeping abilities in different sea states. Upon completion, the report developed the following conclusions (Dipper, 1998):

- The most valuable feature of the hull form is its ability to carry up to 500 mtons of deadweight payload, more than half its lightship displacement, at speeds of up to 43 knots.
- The fuel range of the vessel varies with payloads. With long-range fuel tanks loaded to capacity, operating above 30 knots the vessel is capable of 3,200nm. During normal service with 440 tons of deadweight payload at a speed of 40 knots range falls considerably to 440 nm.
- Sea Keeping trials were performed at various speeds between 30 and 36 knots. Seas also varied with significant wave heights ranging from 4.5 to 13.5 feet. The vessel remained under the levels for shipboard personnel degradation set by the U.S. Navy. Specifically, for all trials the vessel remained below 3 degrees pitch, 8 degrees roll, 0.4g's vertical acceleration, and 0.2 degrees transverse acceleration for significant single amplitude motions.

- The ride control system performance reduced pitch amplitude by 33% to 50%, most notably when operating at speeds greater than 28 knots.
- The addition of military specification may introduce considerable weight gains during construction. However, Incat's lightweight construction techniques may assist in holding down the weight when designing a military specific vessel.

#### **4. Joint Venture (HSV-X1) Lease**

The Joint Venture (HSV-X1) is a 96-meter Wave Piercing Catamaran designed and modified by Incat for the United States military. The original vessel performed ferry services across the Cook Strait in New Zealand. The vessel is part of a two-year, \$20.3 million lease by the Navy, Army, Coast Guard and Special Operations Command. The services are using this lease to determine where high-speed ferries can contribute to DoD and Coast Guard missions.

Modifications to support the lease for DoD include (INCAT, 2001):

- Capable of maintaining speeds of 35 knots with 545 short tons of cargo at a distance of 1110 nautical miles in sea state 3. Cargo can include vehicles, troops and equipment.
- Able to deploy at distances of 4500 nautical miles with 275 short tons of cargo without refueling.
- Crew accommodation and facilities for 40 personnel extending 15 days and over, without replenishment.
- Seating capacity for 325 battle ready troops and their equipment.
- Vehicle deck area and deadweight allowance for 17LAVIII or 14M2A3 fighting vehicles plus troops, equipment and other vehicles.
- A quarter ramp capable of loading/unloading military armored wheeled and tracked vehicles to wharfs and sealift pontoons.
- Ability to launch and recover up to 11 meter Rigid Hull Inflatable Boats in sea state three.
- A helicopter deck capable of landing rotary wing aircraft including the SH-60 and CH-46 during daylight operations.

To support our analysis we will use the HSV-X1 as a basis for comparison to the current LSV options. HSV-X1 is shown below in as Figure 2-1.





Figure 2-1. Joint Venture (HSV-X1) (From: Army Link News, 2001).

## **B. THE REQUIREMENTS OF JOINT VISIONS 2010 AND 2020**

### **1. Dominant Maneuver and Focused Logistics**

The ultimate goal of our military's forces is to defend our nation here and abroad and support the objectives directed by the National Command Authorities. In order to achieve these objectives, Joint Vision 2010 (JV 2010) and Joint Vision 2020 (JV 2020) established the concept of Full Spectrum Dominance – the ability of U.S. forces, operating unilaterally or in combination with multinational and interagency partners, to defeat any adversary and control any situation across the full range of military operations (JV 2020, 2000). Full spectrum Dominance is composed of four basic operational concepts: Dominant Maneuver, Precision Engagement, Full Dimensional Protection, and Focused Logistics. (JV 2010, 1996)

Two of these operational concepts, Dominant Maneuver and Focused Logistics, rely heavily on our ability to rapidly move our forces into a position to overwhelm our enemy, or rapidly deploy our troops and equipment to support the war fighting efforts.

Dominant Maneuver is the ability of our joint forces to gain positional advantage with decisive speed and overwhelming operational tempo in the achievement of assigned military tasks, while Focused Logistics is the ability to provide the joint force the right personnel, equipment, and supplies in the right place, at the right time, and in the right quantity across the full range of military operations. (JV 2020, 2000)

## **2. The Need for New Technologies**

In addition to being able to satisfy the operational concepts described in Full Spectrum Dominance, JV 2010 and 2020 also stress the need to embrace and adapt the latest in technology advancements to lead our nations military into the 21<sup>st</sup> century of war fighting. Central to this concept is the ability to utilize the latest in commercial-off-the-shelf (COTS) technology and adapt it for use in the military, allowing the military to embrace the latest available technologies at minimal cost. Technologically superior equipment has been critical to the success of our forces in combat in the past, and continues to be a driving factor that will determine our future success in combat. As such, it is critical that DoD continues to pursue the latest technologies in both COTS and non-COTS equipment to ensure the future success of our forces in combat.

## **3. The Role of HSFs in Satisfying JV 2010 and 2020 Requirements**

JV 2010 states “power projection from the United States, achieved through rapid strategic mobility, will enable the timely response critical to our deterrent and war fighting capabilities. Our overseas presence and highly mobile forces will both remain essential to future operations.” (JV 2010, 1996) We propose that HSFs, serving as LSVs in support of JLOTS, could be uniquely suited to satisfy the requirements of JV 2010 and 2020, as they provide a rapid, flexible, responsive, and technologically advanced platform to transport our troops and equipment from ship to shore across a broad spectrum of environments and conditions. Additionally, we propose that modern-day, commercially available HSFs will be able to perform these missions with only minor modifications, allowing DoD to embrace the use of a technologically advanced COTS system that is available today.

HSFs may also be a key factor in ensuring the timely response and rapid strategic mobility required of our nation’s strategic military forces by JV 2010 and 2020. As will be discussed in Chapter III, HSFs have the potential to be effectively used in a variety of

applications as LSVs in support of JLOTS operations, ensuring we maintain the capability to meet force closure requirements in theater as required by the Joint Chiefs of Staff. We aim to prove in Chapter III that HSFs can enable the Combatant Commanders to conduct in-stream discharge of strategic sealift ships at the most productive site available, allowing them to project our power abroad and rapidly deploy our forces and their equipment in support of National Military Strategy objectives. The speed, lift capability, versatility, and range of HSFs currently in use and being developed by the commercial sector may provide a viable platform to ensure our forces can meet the demanding needs of maintaining the highly mobile and agile forces required in the 21<sup>st</sup> century.

### **C. JOINT LOGISTICS OVER-THE-SHORE (JLOTS)**

#### **1. An Overview of JLOTS Operations**

“Logistics Over-the-Shore (LOTS) is the process of discharging cargo from vessels anchored off-shore or in-the-stream, transporting it to the shore and/or pier, and marshalling it for movement inland.” (JP 4-01.6, 1998) LOTS operations can be conducted over unimproved shorelines, through fixed-ports inaccessible to deep draft ships, and through fixed-ports that would prove inadequate without using LOTS capabilities. Both the Army and the Navy may conduct LOTS operations, with the scope of the LOTS operation depending on geographic, tactical, and time considerations. Joint Logistics Over-the-Shore (JLOTS) operations are defined as “operations in which Navy and Army LOTS forces conduct LOTS operations together under a Joint Force Commander (JFC)”. (JP 4-01.6, 1998) Since most modern-day operations are conducted in the joint arena, most LOTS operations both now and in the future will also be joint.

Strategic sealift ships are the most common assets supported by JLOTS operations, and are the principal means of delivering the equipment required for the logistical support of our land forces. (JP4-01.6, 1998) Strategic sealift employed in support of JLOTS operations includes Military Sealift Command (MSC) common-user ships and pre-positioning ships, in addition to various cargo ships included in the Ready Reserve Fleet (RRF). These ships are capable of conducting both pier-side port operations and JLOTS operations from anchorage.

## **2. An Overview of JLOTS Equipment**

There are various types of equipment used to support JLOTS operations. The type of equipment used depends on the type of JLOTS operation being performed. The primary naval system used to discharge cargo offshore is the cargo offload and discharge system (COLDS). The standard component of the Navy COLD system is a 5 by 7 foot pontoon, used to construct various configurations of floating barges and causeway sections. The Army equivalent is the Army Modular Causeway System. Both systems can be configured as powered or non-powered, and are primarily utilized as causeway ferries and piers for transporting and loading/offloading equipment and rolling stock. Additionally, both systems can be configured to form a roll-on/roll-off discharge facility (RRDF), which is the primary means to offload rolling stock from the cargo vessels discharge ramp to the lighterage (powered causeways, barges, and LSVs) for further delivery to either the beach or a port.

The elevated causeway system (ELCAS) is a key element in transporting containerized cargo ashore in an unimproved beach area. The ELCAS system provides the capability to offload lighterage from beyond the surf zone where difficult beach gradients exist that preclude the lighterage from making a beach front delivery. The ELCAS system is constructed from 8 by 40 foot modules that form a roadway system and pier capable of extending up to 3,000 feet from the beach. The ELCAS system includes all equipment necessary for retrieving and delivering containerized cargo to the beach, including a beach ramp, turntables, and cranes.

## **3. Common JLOTS Logistic Support Vessels (LSVs)**

The primary means of offloading the strategic sealift ships utilized in JLOTS operations is by means of lighterage, which consists of LSVs, landing craft, amphibians, causeway ferries, and barges. The characteristics of each type of lighterage vary greatly among each type, as displayed in Figure 2-2 below.

REPRESENTATIVE LIGHTERAGE CHARACTERISTICS										
Class	Capacity (stons)	Crew	Length	Beam	Draft (Full Load)	Speed	Troops	Cargo Area L x Max W (x Min W)	Light Displacement (tons)	Ramp (Width)
LCU 1600	160.0	12	135' 3"	29' 0"	3' 2" fwd	12 kts lt	350 <sup>2</sup>	121'x25' (x 14')	191.5	Bow 14' Stern 18'
LCU 2000	350.0	12	175' 0"	42' 0"	5' fwd 9' aft	12 kts lt 10 kts full	350 <sup>2</sup>	100'x38'	550	16'
LSV	2000	29	273'	60'	12' fwd 16' aft	12 kts	900 <sup>2</sup>	160'x58'	4266	Bow 26' Stern 24'
LCM-8 (Steel)	65.0	5	73' 7"	21' 0"	3' 10" fwd 5' 2" aft	12 kts full	150	42'9"x14'6"	67	14'6"
LCM-8 (Alum.)	65.0	5	74' 3"	21' 0"	3' fwd 4' 8" aft	12 kts full	200	42'9"x14'6"	37.8	14'6"
CSNP	90.0	N/A	92' 0"	21' 0"	4'	N/A	N/A	92'x21'	70	N/A
CSP	35.0	6	85' 0"	21' 0"	40"	7 kts lt	N/A	60'x21'	88	N/A
SLWT	N/A	8	84' 0"	21' 0"	40"	7 kts lt	N/A	N/A	103	N/A
LARC-V	5.0	2	35' 0"	10' 0"	4' 1" fwd 4' 4" aft	9 kts water 29.5 mph land	20	16'x10'	10.5	N/A
LARC-LX	60.0 <sup>1/</sup>	8	61' 1"	26' 7"	8' 2" fwd 8' 8" aft	6.5 kts lt	125	37'x13'8"	56	14'6"
LCAC	60.0 <sup>1/2</sup>	5	87' 11"	47' 0"	0-3'	40 kts full	24	71'x27'	99	Bow 27' Stern 15'
1/ Overload condition is 75 tons. 2/ While landing craft utilities are capable of carrying troops, this should only be done in extreme situations when the distance and time of travel are under 2 hours in sea states less than 2. These craft are not designed to transport troops in high sea state.										

Figure 2-2. Representative Lighterage Characteristics (From: JP 4-01.6, 1998).

As displayed in Figure 2-2, the capabilities each type of lighterage, such as length, speed, draft, capacity, and crew size, vary greatly among them. As such, some types of lighterage are capable of carrying multiple types of cargo, such as rolling stock, break-bulk cargo, and containerized cargo, while others are better suited to carrying only one or two types of cargo. As the strategic sealift ships used in JLOTS operations each carry different types of cargo, the type of lighterage used depends on the asset being offloaded, as identified in Figure 2-3 below.

LIGHTERAGE UTILITY FOR DIFFERENT TYPES OF SHIPS	
SHIP TYPE	LIGHTERAGE
BREAKBULK	LCU, LCM-8, LARCX-LX
CONTAINERSHIP	CAUSEWAY FERRY, LCU <sup>1/</sup> , LARC-LX, LSV
RO/RO	CAUSEWAY FERRY, LCU, LCM-8 <sup>2/</sup> , ARMY LSV
LASH	CRAFT FOR BARGE TOWING <sup>3/</sup>
SEABEE	CRAFT FOR BARGE TOWING <sup>3/</sup>
1/ For containers, LCUs 1600 and 2000s can be off-loaded at the ELCAS; the LSV can only be off-loaded at a causeway pier. 2/ Army rhino horn-equipped LCM-8s only. 3/ LASH and SEABEE barges can only be off-loaded by ELCAS or shoreside cranes.	

Figure 2-3. Lighterage Utility for Different Types of Ships (From: JP 4-01.6, 1998).

As the focus of this thesis relates to HSFs augmenting and replacing existing LSVs and landing craft, the discussion of lighterage used to support JLOTS operations will be limited to LSVs and landing craft. For ease of discussion, the term LSV as used in this thesis will include the Frank S. Besson Class LSV and all Army and Navy landing craft.

**a. Frank S. Besson Class LSV**

At 273 feet in length, the Frank S. Besson Class LSV is the largest of the LSVs used to support JLOTS operations. In service since the late 1980's, there a total of six, all assigned to the U.S. Army. These ships provide Roll-on/Roll-off (RO/RO) drive-through capability of rolling stock by means of a bow ramp and stern ramp, and can transport containerized cargo, break-bulk (loose or palletized) cargo, and rolling stock (wheeled and tracked vehicles). With a design draft of 12 feet, they can transport cargo to shallow terminal areas, remote under-developed coastlines, and on inland waterways. These ships possess the ability to carry up to 2000 short tons (stons) of cargo for 8,300 miles at 11.6 knots. With a crew of 29 and full messing and berthing facilities, they are self-sustaining and are the only LSV capable of self-deploying and conducting a trans-oceanic voyage. An example of a Frank S. Besson Class LSV is shown below as Figure 2-4.



Figure 2-4. Frank S. Besson Class LSV (From: Naval Technology, 2001).

***b. Landing Craft Utility 2000 Class***

At 175 feet in length, the Army 2000 Class Landing Craft Utility (LCU-2000 Class) is the second largest of the LSVs. With the first LCU-2000 Class delivered to the Army in 1990, it is also the newest class of LSV. There are a total of thirty-five in service, all assigned to the U.S. Army. Fitted with a bow ramp, they are capable of performing RO/RO operations, and can carry containerized cargo, break-bulk cargo and rolling stock. With a forward draft of five feet, they are capable of shallow water operations and can beach and retract under their own power. They can carry up to 350 stons of cargo for 4,500 miles at 11 knots. With a crew of 13 and full messing and berthing facilities, they are self-sustaining, although their flat-bottom hull design limits their ability to self deploy in terms of conducting trans-oceanic voyages. As such, they are typically either pre-positioned or transported to the site of JLOTS operations by the use of a Heavy Lift Prepositioned Ship (HLSP), such as the strategic sealift SEABEE ships. An example of an LCU-2000 Class LSV is shown below as Figure 2-5.





Figure 2-5. Army LCU-2000 Class LSV (From: Military Analysis Network, 2001).

*c. Landing Craft Utility 1600 Class*

The predecessor to the LCU-2000 Class LSV is the LCU-1600 Class LSV. Designed and built in the 1970's, the LCU-1600 Class is one of the oldest class of LSVs use to support JLOTS operations. There are a total of fifty-one is service, with 38 assigned to the U.S. Navy and 13 assigned to the U.S. Army. The LCU-1600 Class is 160 feet in length, and can carry 160 stons for 1,200 nautical miles at 8 knots, with a maximum speed of 11 knots. Like the LCU-2000 Class, they are fitted with a bow ramp to perform roll-on/roll-off operations, and can carry containerized cargo, break-bulk cargo, and rolling stock. With a draft of 3 feet, 2 inches, these ships can perform shallow water operations and are capable of beaching and retracting under their own power. With a crew of 12 and full messing and berthing facilities they are self-sustaining, although due to their limited range and flat-bottom hull design, they are not capable of self-deploying. As such, these craft are either pre-positioned or carried on board U.S. Navy



amphibious ships or strategic sealift SEABEE ships to the site of the JLOTS operations. An example of an LCU-1600 Class LSV is shown below as Figure 2-6.



Figure 2-6. LCU-1600 Class LSV (From: Military Analysis Network, 2001).

***d. Mechanized Landing Craft***

At 74 feet in length, the Mechanized Landing Craft (LCM-8 Type) is the smallest of the conventional LSVs. Both the U.S. Navy and U.S. Army maintain a fleet of approximately 100 each of these LSVs. The LCM-8 Type LSV is capable of carrying 65 tons of cargo for 190 miles at 9 knots. Fitted with a bow ramp, the LCM-8 is capable of performing roll-on/roll-off operations and primarily carries rolling stock and break-bulk cargo. With an overall draft of 4 feet, these craft are capable of performing shallow water operations and can beach and retract under their own power. They maintain a crew of 5, and are not self-sustaining, although they can operate on a 24-hour basis with two crews, and are either pre-positioned or transported to the JLOTS sites on U.S. Navy amphibious ships or strategic sealift SEABEE ships. An example of an LCM-8 Type LSC is shown below as Figure 2-7.



Figure 2-7. LCM-8 Type LSV (From: Military Analysis Network, 2001).

*e. Landing Craft Air Cushion*

The fastest of the LSVs is the Landing Craft Air Cushion (LCAC). At 87 feet in length, the LCAC can carry up to 60 stons for 200 miles at 40 knots, or 300 miles at 35 knots. There are approximately 80 LCAC's in service, all assigned to the U.S. Navy. Unlike the conventional LSVs, the LCAC employs air cushion vehicle technology with gas turbine engines to ride on a cushion of air above the surface, both on land and in water. Fitted with a bow ramp, the LCAC can carry a variety of rolling stock and break-bulk cargo for delivery to the shore. With a crew of 5, the LCAC's are not self-sustaining, although they can perform extended operations with crew changes and refueling. They are primarily transported to the site of JLOTS operations via U.S. Navy amphibious ships. An example of an LCAC is shown below as Figure 2-8.



Figure 2-8. LCAC (From: Military Analysis Network, 2001).

#### **4. The Importance of JLOTS**

With the increased tempo and complexity of modern day military operations, the ability of the U.S. Armed Forces to rapidly respond to any crisis has become increasingly important. As a result, the requirements for force closure times have shrunk, thus increasing the need to rapidly transport our troops and equipment to the relevant Area of Operations (AO). While DoD has relied heavily in the past on strategic airlift for initial force buildup requirements, it has become increasingly more reliant in modern times on strategic sealift to meet both force closure and force sustainment requirements. While strategic airlift is a crucial part of force buildup and closure, there are simply not enough strategic airlift assets to support the logistical requirements of today's missions. (JCS, MRS-05, 2000) The importance of sealift was demonstrated during Desert Shield/Desert Storm, where strategic sealift assets were used to move three million short tons of cargo, representing 84% of all cargo moved during the combined operations. (Mathews, 1996) Additionally, strategic sealift has become a crucial asset in transporting cargo and

equipment to austere environments that are not capable of being reached by strategic airlift.

This increased reliance on strategic sealift for force build-up and sustainment has amplified the importance of JLOTS operations. While the majority of strategic sealift ships, both organic and commercial, are deep draft vessels, the worldwide number of deep draft ports and berths existing to offload these vessels remains limited. Additionally, port congestion and port denial remain major concerns that can limit the ability of the strategic sealift ships to offload pier side. In order to offset these limitations and retain the ability to offload the strategic sealift ships to meet force closure guidelines, DoD has become increasingly more reliant on JLOTS. The use of JLOTS provides DoD with the capability and flexibility to successfully offload in an austere environment for further transport to the AoA.

## **5. JLOTS System Limitations**

The JLOTS systems and sub-systems are inter-dependent, weather-dependent, and should be inter-operable between the services. (JP 4-01.6, 1998) As a result of these interdependencies, there arise several factors that limit the system performance of JLOTS operations. Through our analysis in Chapter III, we hope to show that HSFs can be successfully used to overcome some of these limitations.

Perhaps the greatest limiting factor of the JLOTS system is its ability to perform in sea states greater than three (wave height above five feet). Although the Army and Navy have established the ability to operate in all sea conditions through sea state 3 (SS3) as the threshold capability for conducting JLOTS operations, several of the system components in JLOTS are not capable of achieving that threshold. (JP 4-01.6, 1998) Currently, none of the LSVs supporting JLOTS operations are capable of conducting an offload from a strategic sealift ship in SS3. This is primarily due to the dissimilar motion caused by the transport vessels and LSVs. The roll motion of the sealift ships and the motion of the lighters or causeway systems alongside create a relative motion interface problem. The RO/RO sealift ships ramps are not designed to withstand this relative motion, making offload to a causeway or lighter hazardous. Additionally, the flat bottom hull design of the LSVs, coupled with their relatively slow speed (with the exception of

the LCAC), makes transiting during SS3 in a loaded condition potentially hazardous, due to the increased wave and surf motion.

A second limiting factor is the inability of all the LSVs, with the exception of the Frank Besson Class, to self-deploy. As such, the majority of the LSVs must either be pre-positioned or transported to the site of the JLOTS operations. Unless the LSVs are pre-positioned or transported concurrently with the strategic sealift, the potential exists for them to arrive at the JLOTS site after the strategic sealift vessels they are destined to offload. This could prove to be a serious limiting factor in conducting timely JLOTS operations and meeting force closure requirements. Additionally, although the Frank Besson Class of LSV is capable of self-deploying at a speed of 11.6 knots, it can't keep pace with the strategic sealift ships, which average 24 knots while transiting.

With the exception of the LCAC, all LSVs are limited to a maximum of 11 knots fully loaded. The slow service speed limits the acceptable range over which JLOTS operations can be conducted while still meeting force closure requirements. As a result, most JLOTS operations must be conducted within 1-2 miles of the beach or port to which the cargo will be offloaded. This has the potential to put the strategic sealift ships closer to a potentially hostile environment, as opposed to conducting offload operations over-the-horizon where they would be out of harm's way. While the LCAC is capable of obtaining speeds of up to 40 knots and conducting over-the-horizon JLOTS operations, it is limited in both the type and amount of cargo it can carry, at 60 short tons of rolling stock and break bulk cargo.

#### **D. SUMMARY**

To prepare for the analysis that will be conducted in Chapter III, we have provided relevant background information pertaining to current HSF technology in terms of commercial trends and DoD HSF initiatives. We have also discussed the basic principles of JLOTS operations, to include equipment and limiting factors relevant to the analysis in this thesis. Finally, we have provided the basic technical requirements for the Army's TLV program in terms of commercial capabilities.

Chapter III will analyze HSFs, concentrating on the distinct advantages HSFs exhibit over current Logistic Support Vessels (LSVs) used to support JLOTS operations.

It will also discuss how HSFs can best be employed as modern day LSVs in conducting these operations. Additionally, the analyses will consider how HSFs can serve to reinvent the methods for conducting current and future JLOTS operations.

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### **III. ANALYSIS OF HIGH SPEED FERRIES FOR USE BY DOD**

Whereas Chapter II provided pertinent background information on the basic principles of High Speed Ferries (HSFs) and Joint Logistics Over-the-Shore operations, this chapter analyzes HSFs, concentrating on the distinct advantages HSFs exhibit over current Logistic Support Vessels (LSVs) used to support JLOTS operations, and discusses how HSFs can best be employed as modern day LSVs in conducting JLOTS operations. In discussing the advantages of HSFs over current LSVs, the analysis focuses primarily on advantages achieved by HSFs over current LSVs in the areas of speed, range, payload, and flexibility. Additionally, the analyses will consider how HSFs can serve to reinvent the methods for conducting future JLOTS operations. Ultimately, we hope to show through our analysis that HSFs can be successfully employed by DoD as a modern day LSV to either augment or replace existing LSVs in conducting JLOTS operations.

In conducting this analysis, we will be using the Joint Venture (HSV-X1) as the HSF platform from which we draw our baseline data, as it represents the most likely version of an HSF that would be employed by DoD for use in conducting JLOTS operations. As introduced in Chapter II, the HSV-X1 is the 96-meter Wave Piercing Sealift Catamaran designed and built by Incat of Australia that is currently being leased jointly by the Army, Navy, and Coast Guard to conduct and evaluate the possible future uses of HSFs by DoD. The HSV-X1 employs commercial HSF technology in addition to minor technical and structural modifications to make it suitable for military duty

#### **A. ADVANTAGES OF HSFS OVER CURRENT LSVS**

In addition to providing background on the various types of LSVs use to support JLOTS operations, Chapter II also introduced some of the limitations of these LSVs, focusing primarily in the areas of speed, range, payload, and flexibility. While each of the LSVs currently used to support JLOTS operations maintain certain advantages in each of the areas outlined above, each of these LSVs also exhibit certain limitations in each area. As a result of these limitations, no one LSV is best suited to satisfy all the requirements of conducting the various JLOTS operations that were described in Chapter



II. Instead, these LSVs tend to be utilized for one or two specific types of JLOTS operations, such as beachfront or developed port operations.

By overcoming the disadvantages that the current LSVs exhibit in the areas of speed, range, payload, and flexibility, the potential exists for HSFs to be successfully utilized as modern day LSVs in conducting various JLOTS operations. These JLOTS operations could include both developed and undeveloped port operations, beachfront operations, and over-the-horizon operations. What follows next is an analysis of the advantages of HSFs over current LSVs in the areas of speed, range, payload, and flexibility.

### **1. Speed**

Perhaps one of the most significant advantages that HSFs possess over all but one of the current LSVs used to support JLOTS operations is that of speed. With the exception of the Landing Craft Air Cushion (LCAC), which is capable of achieving a top speed of 40 knots, all other LSVs used to support JLOTS operations are limited to a maximum speed of 7-12 knots. Additionally, each of these LSVs is designed to operate in sea states two or less, with the exception of the Frank S. Besson Class LSV, which can operate in sea state three. While these operating characteristics may prove to be merely sufficient in conducting JLOTS operations, they severely limit both the range and sea state in which JLOTS operations can be conducted, requiring that most JLOTS operations be conducted relatively close to shore (within 1-5 miles) in relatively calm seas (sea state two or less). While LCACs possess an advantage in speed, they are limited by both the amount and type of cargo they can carry as discussed in Chapter II.

Looking at the HSV-X1 as our baseline HSF, it is capable of a maximum operational (fully loaded) speed of 35 knots and a maximum lightship (empty) speed of 48 knots. Additionally, the vessel maintains the ability to successfully operate in sea states greater than two. These two characteristics give the HSF distinct advantages in speed over the current LSVs used to support JLOTS operations, allowing the conduct of JLOTS operations at greater distances than previously permitted and in greater sea states, while at the same time providing the ability to deliver the cargo shore side or pier side in the same amount of time or faster than current LSVs.

## **2. Range**

Range provides another distinct advantage of HSFs over current LSVs. While the LSVs discussed in Chapter II are capable of an operational range of 1-5 nautical miles (NM), which is the requirement to conduct current JLOTS operations, the only LSV that is capable of conducting a trans-oceanic voyage to the site of the JLOTS operations is the Frank S. Besson Class LSV. However, that class of ship is limited to a maximum transit speed of 12 knots, which is generally lower than the average transit speed of the ships carrying the JLOTS equipment and cargo. The remaining LSVs discussed in Chapter II must be transported to the JLOTS operational area by the strategic sealift ships identified in Chapter II.

The HSV-X1 is both self-sustaining and capable of conducting a trans-oceanic voyage to the site of the JLOTS operations at a maximum speed of 48 knots when empty. The HSV-X1's speed gives it the ability to deploy to the JLOTS operational area with minimal transit time compared to the Frank S. Besson class LSV. Additionally, once on site, the HSF has the ability to carry 400 short tons (stons) of cargo at distances of up to 2200 nautical miles. This gives the HSV-X1 the ability to carry large payloads at distances greater than or equal to all of the existing LSVs with the exception of the Frank S. Besson class, which can carry 2000 stons 8,300 NM, and the LCU-2000 class, which can carry 350 stons a distance of 4,500 miles.

## **3. Payload**

Another area where HSFs hold a distinct advantage over current LSVs is payload capacity, both in terms of weight and types of payload. While the two largest of the current LSVs, the Frank S. Besson class and the LCU-2000 class, can carry 2000 stons and 350 stons respectively, the capacity of the next largest and most common LSV, the LCU-1600 class, drops off sharply to only 160 stons. In terms of square feet of available deck space, the Frank S. Besson class has the greatest capacity of the current LSVs, at 9,280 square feet, followed by the LCU-2000 class at 3,800 square feet, and the LCU-1600 class at 3,025 square feet. The cargo-hold design of all the current LSVs is a single-deck, open-air configuration. As such, all cargo, equipment, and personnel being transported are subjected to the environment and any weather extremes. Additionally, the

current LSVs are primarily designed to carry cargo, equipment, and rolling stock, not personnel. While they can carry personnel for relatively short trips of 1-2 hours via their open cargo-hold, they are not equipped with the accommodations to carry personnel safely or efficiently over-the-horizon, or in sea states greater than two, as might be envisioned in JLOTS operations of the future.

In contrast to the current LSVs, the HSV-X1 is capable of carrying not only 815 stons of cargo in a variety of configurations, but also maintains the seating capacity to safely carry up to 363 personnel (including 45 crew members) for relatively long trips (several hours or more) in sea states greater than two. In terms of cargo configuration, the HSV-X1 maintains a total of 22,964 square feet of deck capacity on multiple decks which is more than twice the capacity of the largest LSV currently in use, the Frank S. Besson class LSV.

To provide the greatest flexibility in terms of both payload configuration and capacity, the HSV-X1 is designed with three structurally reinforced decks configured as follows: the third (upper) deck is 10,850 square feet at 6'6" clear height, the second (middle) deck is 8,078 square feet at 13'1" clear height, and the first (lower) deck is 4,035 square feet at 15'3" clear height. The multiple-deck layout of the HSV-X1 gives it not only the ability to carry more square feet of cargo than any of the current LSVs, but also the ability to carry a greater variety of cargo spread across multiple levels, ranging from rolling stock, to break bulk cargo, to personnel. The structural reinforcements made to the deck allow the ship to carry the majority of the Army and Marine Corps pre-positioned rolling stock assets. Additionally, as all the decks and the personnel seating area are enclosed within the hull of the ship, all cargo, equipment and personnel are protected from the environment and any weather extremes that may exist during their transport.

#### **4. Flexibility**

While current LSVs are well suited to carrying a variety of cargo over relatively short distances in calm seas, they are limited in their flexibility by a number of factors discussed in the preceding paragraphs, including their relatively slow speed, their inability to operate in sea states greater than two, their inability to carry personnel for anything greater than 1-2 hours, and their inability to effectively operate over-the-

horizon. Additionally, none of the current LSVs are equipped with a helicopter deck, only two possess the ability to self-deploy at a maximum transit speed of 12 knots, and only the Frank S. Besson class LSV is capable of conducting a trans-oceanic voyage. As such, the current LSVs used to support JLOTS operations do not provide the flexibility envisioned to conduct JLOTS operations of the future, or provide flexibility in conducting present day JLOTS operations.

To further increase the flexibility through which the HSV-X1 can offload cargo and personnel, it is equipped with both a two-part hydraulically operated vehicle ramp that allows rapid loading and discharging of vehicles from the stern or alongside, and a helicopter landing deck suitable for carrying large military helicopters such as the SH-60 Seahawk and the CH-46 Sea Knight. The configuration of the vehicle ramp allows the HSV-X1 to load rolling stock and cargo from a Roll-On, Roll-Off (RO/RO) ship via a floating causeway, and then directly discharge the rolling stock or cargo alongside a pier to a floating causeway or beach via the elevated causeway system (ELCAS) or Navy cargo offload and discharge system (COLDS). The addition of the helicopter landing deck provides additional flexibility by adding the capability to quickly transport both cargo and personnel to an inland or over-the-horizon site, as well as back to JLOTS ships to deliver or pick-up additional cargo and personnel. This added ability might prove to be extremely valuable if future JLOTS operations are conducted over-the-horizon, as is envisioned by using HSFs as an integral part of future JLOTS operations.

## **B. ADVANTAGES/DISADVANTAGES OF HSFS IN CONDUCTING JLOTS OPERATIONS**

As described in Chapter II we will utilize the HSV-X1 as the basis for our analysis to examine advantages and disadvantages over current LSVs. We identified the various advantages in speed, range, payload, and flexibility in the beginning of this chapter. We will now examine the potential advantages and disadvantages HSFs may exhibit while conducting JLOTS operations. We will first look at general advantages and disadvantages over current LSVs and then look specifically at developed, undeveloped and beach front operations. In order to compare HSFs to current LSVs we are making the following assumptions:

- The HSV-X1's vehicle ramp is compatible with Navy COLD system, the Army Modular Causeway System, the roll-on, roll-off discharge facility (RRDF) and the ELCAS system
- We will use short ton capacity for comparisons
- Loading time equals that of current LSVs for RO/RO loads
- All loading/unloading of the HSV-X1 is performed via the vehicle ramp. Loading into the cargo area is not possible by crane.
- The HSV-X1's load capability is based on a travel distance of 1000NM at 35 knots

These assumptions are necessary to provide a similar frame of reference since there is currently no published data available for conducting JLOTS operations using the HSV-X1. These assumptions are based on current vessel characteristics and the proven ability of the builder to make military additions, as illustrated by the addition of the flight deck, which has already passed a number of naval flight tests in November 2001. (Ferry News, 2001)

#### 1. Advantages in Conducting JLOTS Operations

As discussed previously in this chapter, speed is one of the distinct advantages of the HSV-X1. At a cruising speed of 35 knots fully loaded, the HSV-X1 provides a significant advantage over current LSVs. Table 3-1 compares the HSV-X1 and current LSVs for transit times from ship to shore based on current distances and maximum operating speeds, in sea state one or below, as outlined in the JLOTS publication.

TRANSIT TIME COMPARISON IN MINUTES						
CRAFT	SPEED IN KNOTS	DISTANCE IN NM				
		1	2	3	4	5
HSV-X1	35	2	3	5	7	9
LSV	12	5	10	15	20	25
LCU-2000	10	6	12	18	24	30
LCU-1600	10	6	12	18	24	30
LCM-8	12	5	10	15	20	25

Table 3-1. Transit Time Comparison in Minutes (After: J P 4-01.6, 1998).

The cargo and troop capacities of each craft are shown in Table 3-2. Using this information, Table 3-3 shows the amount cargo, in short tons, that can be moved per minute from ship to shore at the speeds indicated in Table 3-1.

<b>CAPACITY COMPARISON</b>		
<b>CRAFT</b>	<b>CAPACITY (short tons)</b>	<b>TROOPS</b>
HSV-X1	545	325
LSV	2000	900
LCU-2000	350	350
LCU-1600	160	350
LCM-8	65	150

Table 3-2. Capacity Comparison (After: JP 4-01.6, 1998).

<b>TONS MOVED PER MINUTE</b>					
<b>CRAFT</b>	<b>DISTANCE IN NM</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
HSV-X1	317.92	158.96	105.97	79.48	63.58
LSV	400.00	200.00	133.33	100.00	80.00
LCU-2000	58.33	29.17	19.44	14.58	11.67
LCU-1600	26.67	13.33	8.89	6.67	5.33
LCM-8	13.00	6.50	4.33	3.25	2.60

Table 3-3. Tons Moved Per Minute at Table 3-1 Speeds.

As Table 3-3 shows, the HSV-X1 has an advantage in tons moved per minute over all current LSVs except for the Frank S. Besson class. The Besson's class advantage occurs only under ideal operating conditions with little or no sea state. Also, the HSV-X1 is able to maintain 35 knots in sea state three, while the maximum speed of current LSVs is reduced when operating in sea states greater than one.

Table 3-4 shows the impact on tons moved per minute when reducing the speed of current LSVs indicated in Table 3-1 by two knots. This reduction in speed represents a realistic assumption when operating in sea states greater than one. Table 3-4 shows that during a 5NM trip the HSV-X1 and LSV are almost comparable. It is also important to remember that the HSV-X1 can significantly increase its load capacity if the 1000NM distance is reduced. Although no current data is available for the HSV-X1, Table 2-1 shows a representative example of the increase in HSF loads available if distance is decreased. An increase to a 700 short ton load for 200 NM will give the HSV-X1 at 35 knots a comparable transfer rate to the Frank S. Besson class LSV at 12 knots, and a greater transfer rate at 10 knots.

<b>TONS MOVED PER MINUTE</b>					
<b>CRAFT</b>	<b>DISTANCE IN NM</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
HSV-X1	317.92	158.96	105.97	79.48	63.58
LSV	333.33	166.67	111.11	83.33	66.67
LCU-2000	46.67	23.33	15.56	11.67	9.33
LCU-1600	21.33	10.67	7.11	5.33	4.27
LCM-8	10.83	5.42	3.61	2.71	2.17

Table 3-4. Tons Mover Per Minute at Table 3-1 Speeds less 2 knots.

While cargo transfer rate is one advantage, another distinct advantage of the HSV-X1 previously discussed is the protection of the cargo during the transit. None of the current LSVs provide protection from the elements during transfer. As shown by the pictures in Chapter II, all current LSVs have open deck cargo holds. The HSV-X1 has a distinct advantage in this area. All cargo on the HSV is stored within the hull of the vessel. This gives it complete protection against the elements during transit. This applies also to personnel. The JLOTS publication states, “while landing craft utilities are capable of carrying troops, this should be only done in extreme situations” (JP 4-01.6, 1998). The

HSV is designed not only for cargo but can safely move 325 battle ready troops in safety up to sea state three.

The HSV-X1 also holds a major advantage over the current LSVs with the ability to operate helicopters while conducting JLOTS operations. No current LSVs have the capability to embark helicopters. HSV-X1 has proven during recent sea trials the ability to land both SH-60 and CH-46 helicopters while underway at speeds in excess of 35 knots. (Ferry News, 2001) This ability and the addition of a cargo elevator from the cargo deck to the helicopter deck would give the HSV-X1 the flexibility of vertical replenishment (VERTREP) operations while engaged in JLOTS operations.

## **2. Disadvantages in Conducting JLOTS Operations**

Due to their enclosed hull design, HSFs lack the flexibility to load using cranes or booms directly onto their cargo decks. Instead, HSFs must load palletized, break-bulk, and containerized cargo via their quarter ramp using some type of material handling equipment. In contrast, current LSVs maintain the ability to load alongside strategic sealift ships using cranes or booms, which allows for rapid loading of palletized, break-bulk cargo, and containers directly onto their cargo decks.

Fuel economy of HSFs is also a disadvantage. Due to the high horse power requirements for operation of the vessels at high speeds, fuel economy is well below that of current LSVs. Although this is a monetary issue, the cost of operation is a major concern in the present DoD environment. The extent of this disadvantage requires a cost-benefit analysis, which is beyond the scope of the analysis conducted in this thesis.

## **3. Advantages/Disadvantages in Developed Port Operations**

Developed ports represent the easiest scenarios in which to conduct JLOTS operations. If the port is deep enough, ships can off-load without the assistance of LSVs or HSFs. The advantage of HSFs appears when the developed ports are not deep enough for JLOTS ships. All but 17 of the 138 ships listed for strategic sealift in the JLOTS publication have drafts greater than 30 feet. This limits the number of ports that these ships can use; and when ports are not deep enough for pier-side operations, in-stream offloading with LSVs becomes necessary. The HSV-X1 has a fully loaded draft of 12 feet and is equipped with a ramp that is capable of offloading to almost any wharf height. (INCAT, 2001) This capability allows for rapid offloading without the assistance of



cranes. The current LSVs require cranes to offload to wharfs or piers, and although most developed ports are equipped with cranes, this adds to the offload time and gives the HSF a greater flexibility in developed ports, especially those without cranes.

As exhibited when loading alongside strategic sealift ships when in developed ports, HSFs must load and unload via their quarter ramp. HSFs are also only capable of being offloaded using pier side cranes or booms once the cargo has been staged on the quarter ramp. While the quick RO/RO loading and offloading of HSFs is one of its advantages, it also is the major disadvantage due to the inflexibility of loading techniques.

#### **4. Advantages/Disadvantages in Undeveloped Port Operations**

Undeveloped ports present many challenges in JLOTS operations. Many undeveloped ports lack the required depth for large sealift ships to enter, or present hazards to navigation for large vessels. This was the case during Operation RESTORE HOPE in Somalia when sunken equipment presented hazards to navigation. The port in Mogadishu was small, had a draft of only 35 feet and had underwater obstructions that made navigation of large vessels a risky endeavor. (McGrath, 1996) The advantage of HSFs is apparent here, as the HSV-X1's fully loaded draft of 12 feet would not limit its entrance into Mogadishu or similar shallow draft harbors.

Another distinct advantage is the maneuverability of HSFs as described in chapter two. Although current LSVs have the same draft, undeveloped ports pose a different problem. Undeveloped ports do not have the crane support of developed ports. Current LSVs must offload using cranes at wharfs or piers because their bow ramps or stern ramps do not have the ability to lift and reach the wharf or pier. The current HSV-X1 has a quarter ramp that has the capability to reach almost any wharf height. (INCAT, 2001) This quarter ramp gives the HSF a distinct advantage over current LSVs; however, this advantage is only temporary. During JLOTS operations in undeveloped ports specific Army and Navy units are assigned with portable cranes and material handling equipment to offload LSVs. Therefore, HSFs only hold a distinct advantage when these units and their equipment are not deployed or delayed.

HSFs do have a disadvantage due to their length in some undeveloped ports. The current HSV-X1 has a length of 313 feet, which is 50 feet longer than the Frank S. Besson class LSV. The remaining LSVs hold a distinct advantage in maneuverability in undeveloped ports due to their shorter length. The length of the HSV-X1 limits it to undeveloped ports that are large enough to accommodate its 313-foot length. The smaller LSVs such as the LCU-2000, LCU-1600 and LCM-8 are able to operate in smaller ports due to their length being roughly half the size of the HSV-X1 and Frank S. Besson class LSV.

## **5. Advantages/Disadvantages in Beach Front Operations**

Beachfront operations involve offloading directly on to the beach or via a system of causeways as described in Chapter II. The only advantage in beachfront operations is the HSF's ability to offload containers to the ELCAS. This advantage is due to the quarter ramp currently installed on the HSV-X1. The quarter ramp allows the transfer of containers to the ELCAS system without shifting from a starboard to port side moor, which is a requirement for the Frank S. Besson class as described in Joint Pub 4-01.6.

The ability to hold greater amounts of cargo, both in terms of square footage and weight, is also a clear advantage of the HSV-X1 over remaining LSVs when using the ELCAS system. This allows the HSF to load and carry greater amounts of cargo in one trip than all current LSVs in terms of square feet of cargo, and all but the Frank S. Besson class in terms of weight (short tons).

The disadvantage for HSFs is the current inability to offload directly to the beach. All current LSVs have the ability to offload directly to a beach with a moderate beach gradient of 1:15-1:20 as described in Joint Pub 4-01.6. While the HSV-X1 does not have the capability of offloading directly to the beach, there is information available from AUSTAL Shipbuilding stating that future generations of HSFs can be equipped with a bow ramp, enabling them to offload directly to the beach. Although there is no planned construction of this capability on current HSFs, the flexibility and technical capability of the HSF industry makes inclusion of a bow ramp a distinct possibility on future versions. The addition of the flight deck on HSV-X1 is an example of the innovations possible by the HSF industry, and paves the way for future technological enhancements that could be incorporated into military versions of HSFs.

### **C. FUTURE HSF OPERATIONAL CAPABILITIES**

As explained in Joint Pub 4-01.6, “the scope of JLOTS operations extend from acceptance of ships for off-load through the arrival of equipment and cargo at inland staging and marshalling areas.” Current operations revolve around strategic sealift ships off-loaded in ports or anchored off the objective area and off-loaded in stream. These evolutions are conducted after the completion of the amphibious operation, in order to reduce the risk of exposing the strategic sealift assets to hostile forces. JLOTS also serves intratheater movement requirements. While existing LSVs support current JLOTS doctrine, HSFs provide distinct speed and flexibility advantages over current LSVs. The advantages could cause need for new operational doctrine in JLOTS operations, as outlined below:

- Current doctrine details movement from ships to shore at a distance of 5NM. This criterion is due to the limited speed and sea state restrictions of current LSVs. Following the assumptions we outlined previously, distances for conducting JLOTS operations with a fully loaded HSV-X1 can be extended by a factor of 2.9 based on speed alone. This not only extends possible operational area to approximately 15 NM, but can also reduce the risk of attack from enemy forces by moving JLOTS ships over the horizon.
- Logistic support is not only limited to equipment and cargo. In Somalia the risk of flying personnel into Mogadishu was of great concern. MSC responded by chartering a commercial ship to transfer personnel from Mombassa, Kenya to Mogadishu (approximately 500NM). It was determined that the ship was unacceptable for troops. (McGrath, 1996) The use of HSFs would allow for safe personnel transfer from more secure locations into the area.
- Intratheater logistical support is a major concern when operations begin to extend throughout the area of operation. The speed and load capacity of the HSF provide an asset other than aircraft to complete this mission. The lease of an HSF by the III MEF is a prime example of this mission. In a four-month period the WestPac Express transported 5,690 passengers and nearly 6.5 million pounds of cargo at a cost of \$4.8 million. This same movement would have required 128 Air Force C-17 aircraft at a cost of \$5.4 million. (Bongioanni, 2001)
- JLOTS operations begin after the amphibious operation is complete. The speed and range of HSFs can expedite the movement of pre-positioned cargo prior to the arrival of strategic sealift assets. An example would be to pre-position strategic sealift assets at distances of 100NM. Critical equipment and personnel could be shuttled in less than 3 hours to the

established beachhead. This prepositioning allows a faster transfer of equipment in a higher threat area without risking strategic sealift assets.

HSFs not only provide advantages in JLOTS operations but also can serve in many roles once in theater. The Navy Warfare Development Command along with partner commands have published a draft report on the possibilities of modular design based on the HSV-X1 Lease. The report states that based on off-the-shelf technology, HSFs could be configured for the following missions:

- Mine Warfare Command and Control
- Medical Support Facility/NEO/Humanitarian Assistance/Natural Disaster
- Anti-Terrorism Force Protection/Homeland Security/Maritime Intercept Operations.

These additions allow a transformation from a simple logistic support vessel to a flexible asset available to the operational commander.

#### **D. SUMMARY**

As discussed Chapter III, the HSV-X1 possesses certain advantages over current LSVs in the areas of speed, range, and payload. It is these advantages that give the HSV-X1 the ability to not only perform modern day JLOTS operations with greater flexibility than current LSVs, but also the added ability to perform JLOTS operations that may be envisioned for the future. The HSV-X1 represents a significant leap over current LSVs in terms of its capacity to perform a variety of JLOTS related operations, to include:

- Self-deployable to the site of JLOTS operations at speeds of forty-eight knots.
- Ability to carry 545 short tons of cargo nearly 1000 nautical miles at speeds of thirty-five knots
- Safe transport for a total of 363 personnel in various weather conditions and sea states greater than two.
- Flexibility to load a variety of cargo on multiple decks.
- Addition of a helicopter landing deck.

It is the combination of these abilities and the identified advantages that create the potential for HSFs to serve as a flexible and viable asset to augment or replace current LSVs in support of JLOTS operations.

Chapter IV provides a summary of the previous chapters and offers conclusions and recommendations based on the research and analysis conducted. Additionally, the chapter provides ideas for further study in the area of DoD uses of HSF technology.

## **IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

The final chapter of this thesis provides a summary, conclusions and recommendations based on the research and analysis of High Speed Ferries (HSFs) and their potential to serve as Logistics Support Vessels (LSVs) in support of Joint Logistics Over-the-Shore (JLOTS).

### **A. SUMMARY**

Joint Vision 2010 (JV 2010) states "power projection from the United States, achieved through rapid strategic mobility, will enable the timely response critical to our deterrent and war fighting capabilities. Our overseas presence and highly mobile forces will both remain essential to future operations" (JV 2010, 1996). One of the principal methods for rapidly deploying our nation's military equipment overseas is through the use of JLOTS, as discussed in Chapter II. However, the speed at which JLOTS operations can be conducted weighs heavily on the abilities of the LSVs used to support JLOTS. While current LSVs are able to conduct JLOTS operations under most conditions, they do not represent the most technologically advanced or capable LSV platforms available today.

To lead our nation into the 21st century of warfighting envisioned in JV 2010 and 2020, we propose that HSFs, representing the latest in high speed shipping technology and capability, could be successfully utilized as LSVs in support of JLOTS operations. We suggested that by using HSFs as LSVs during JLOTS operations, DoD could employ a technically advanced and highly capable platform that could augment or replace current LSVs.

Through our research and analysis, we showed that HSFs exhibit certain advantages in speed, range, and payload, that combined, allow HSFs to serve as a flexible platform in conducting various JLOTS operations. Additionally, we discussed the types of JLOTS operations that HSFs would be best suited for, in addition to the types of JLOTS operations that they may not be well suited for.

## **B. CONCLUSIONS AND RECOMMENDATIONS**

### **1. Conclusion: HSFs Possess Certain Advantages in Speed, Range, and Payload Over Existing LSVs Used to Support Current JLOTS Operations**

As discussed in Chapter III, HSFs maintain an advantage in speed, range, and payload over existing LSVs in all but a few cases. In terms of speed, modern day HSFs represented by the HSV-X1, are capable of operating at speed in excess of 35 knots fully loaded, compared to a maximum operational speed of 12 knots fully loaded for current LSVs. The HSV-X1 also maintains an advantage in range, able to carry 400 short tons of cargo up to 2,200 nautical miles (NM). The only current LSV capable of carrying the same payload greater distances is the Frank S. Besson class, which can travel 8,300 NM fully loaded. Additionally, the HSV-X1 is self-sustaining and capable of conducting a trans-oceanic voyage at 48 knots when empty. The only current LSV capable of the same voyage is the Frank S. Besson class; however, it is limited to a maximum operating speed of 12 knots.

The HSV-X1's advantage in payload over existing LSVs is two-fold. First, the HSV-X1 maintains 22,964 square feet of storage capacity on multiple enclosed decks, whereas the largest of the current LSVs, the Frank S. Besson class, maintains only 9,280 square feet of storage capacity on a single open deck. Second, not only is the HSV-X1 capable of carrying up to 815 short tons of cargo in sea states greater than two, but it also maintains the seating capacity to safely carry up to 363 personnel. The only current LSV capable of carrying a greater payload than the HSV-X1 is the Frank S. Besson class, which can carry up to 2000 short tons of cargo. However, unlike the HSV-X1, none of the current LSVs are designed to safely operate in sea states greater than two, nor do they maintain the seating capacity to safely transport large numbers of personnel.

These advantages create the possibility for HSFs to serve as a modern-day LSV in support of JLOTS operations, permitting greater flexibility in the conduct of JLOTS operations than is available with current LSVs. By using HSFs to either augment or replace existing LSVs, both the range and speed at which JLOTS operations can be conducted can be increased, allowing the Combatant Commander greater flexibility in

choosing from a number of strategically viable sites from which to conduct JLOTS operations, while at the same time allowing for rapid and sustainable force projection.

**2. Conclusion: HSFs, Serving as LSVs in Support of JLOTS, Satisfy the Operational Concepts of Focused Logistics and Dominant Maneuver Outlined in Joint Visions 2010 and 2020**

As discussed in Chapter II, the concept of Dominant Maneuver is the ability to rapidly move our forces into a position to overwhelm our enemy, or rapidly deploy our troops and equipment to support the war fighting cause. Working in unison with Dominant Maneuver is the concept of Focused Logistics, which is the ability to provide the right personnel, equipment, and supplies in the right place, at the right time, and in the right quantity across the full range of military operations. (JV 2020, 2000) Based on our analysis conducted in Chapter III, HSFs, serving as LSVs in support of JLOTS, are uniquely suited to satisfy the operational concepts of Dominant Maneuver and Focused Logistics. Encompassing the advantages of speed, range, and payload discussed in Chapter III, HSFs provide a rapid, flexible, responsive, and technologically advanced platform for transporting our troops and equipment from ship to shore across a broad spectrum of environments and conditions.

HSFs give Combatant Commanders the ability to conduct in-stream discharge of strategic sealift ships at a choice of strategically sound yet productive sites, allowing them to project our nations power abroad and rapidly deploy our forces and equipment in support of National Military Strategy objectives. Additionally, commercially available HSFs will be able to perform these missions with only minor modifications, allowing DoD to embrace the use of technologically advanced systems available today, as exhibited by the current lease of the HSV-X1.

**3. Conclusion: HSFs Would Provide Greater Flexibility to JLOTS Planners in Future JLOTS Operations**

In today's political and military environment, the military needs flexibility and speed to conduct its operations. Our research has shown that HSFs can operate as LSVs in a military environment. The use of the HMAS JERVIS BAY and the lease of the Westpac Express by the III MEF were the first steps demonstrating the flexibility and advantages in HSF technology.



Our analysis in Chapter III detailed the advantages HSFs would provide if used in JLOTS operations. They provide a flexibility that allows planners to increase distances up to 15 NM on speed alone. This distance is three times greater than current planning for JLOTS operations. HSFs also add an additional capability of helicopter support. Although helicopters are not considered in any current JLOTS planning, the ability of the HSV-X1 to embark helicopters provides a capability for planners to increase flexibility of loading and unloading cargo and personnel to the beach. Current LSVs are unable to embark helicopters. The ability to operate in SS-3 also provides a significant advantage over current LSVs.

Although our analysis also detailed certain disadvantages, we believe they far outweigh the advantages. As outlined in Chapter III, HSFs do have certain disadvantages when compared to current LSVs:

- HSFs are unable to load and unload directly into cargo holds using cranes and booms
- HSFs are longer than all current LSVs and can limit their ability to operate in small, unimproved ports
- Current HSFs are not designed to offload directly to beachfronts
- HSFs require high horsepower engines which leads to poor fuel economy compared to current LSVs

Although HSFs are not superior in all aspects of JLOTS operations over current LSVs, the advantages in speed, range and payload allows JLOTS planners a large degree of flexibility in the planning process. The flexibility advantage combined with the HSFs ability to adapt to other operations (detailed in Chapter III) allows HSFs to overcome their limited disadvantages over current LSVs. HSFs are not a replacement for the entire fleet of current LSVs, but they provide such a significant improvement in technology and flexibility that they are an alternative for re-capitalization of the aging LSV fleet.

#### **4. Conclusion: HSFs can Provide DOD with the First Vessels Designed to Fulfill Many Primary At-Sea Missions across Services**

The draft report by the Naval Warfare Development Center, the III MEF lease of the Westpac Express, the COMPHIBRON-5 exercises with the HMAS JERVIS BAY, and our research provide a picture of the missions that can be fulfilled using HSFs. The spectrum of operations include:

- Special Operations Support
- Inter-theater Logistics Support
- JLOTS operations
- Mine Warfare Command and Control
- Medical Support Facility/NEO/Humanitarian and Natural Disaster Support
- Anti-Terrorism Force Protection/Homeland Security/Maritime Intercept Operations

HSFs can be looked at as the Joint Strike Fighter of the sea, a single system that can provide a variety of missions across services.

**5. Recommendation: NWDC, as the Lead Agency in the HSV-X1 Lease, should Continue Coordinating the Testing and Evaluation of HSFs for Military Use, Closely Examining the Possibilities for HSFs to Serve as LSVs in Support of JLOTS Operations**

Through the current lease of the Joint Venture (HSV-X1), DoD has the opportunity to further test and evaluate the capabilities for HSFs to serve as LSVs in support of JLOTS operations. Early testing of the 91-meter INCAT 046 by NSWC Carderock Division showed great promise for the logistical capabilities of HSFs; and through the continued testing of the HSV-X1, DoD will be able to further investigate the many possible military roles that HSFs can perform, including those of an LSV in support of JLOTS operations. During the two-year lease of the HSV-X1, the Navy, Army, and Marine Corps should capitalize on the opportunity to include the HSV-X1 in as many JLOTS operations tests as possible. The joint lease of a HSF by the Army, Navy, and Coast Guard provide DOD with the opportunity to advance JLOTS operations into the 21<sup>st</sup> Century. This is more than just a mere improvement in technology; HSFs have the capacity to transform the way JLOTS operations are conducted in the near future. The HSV-X1 lease would permit real world testing of a HSF in a JLOTS environment, and would hopefully serve to reinforce and validate the findings of this thesis.

**C. RECOMMENDATIONS FOR FURTHER STUDY:**

In addition to the benefits of using HSFs as LSVs in conducting JLOTS operations, we feel that there are several other areas for additional research on HSFs:

- One disadvantage of current HSFs is the fuel consumption required for operational speeds of 35+ knots. Research should concentrate on a cost-

benefit analysis of HSF procurement, operation, and maintenance costs compared to the current LSV fleet.

- Although the HSV-X1 program is in the early stages, trials with the vessel could provide information on loading and unloading a HSF in a JLOTS environment. This data would allow a simulation study comparing HSFs and current LSVs in JLOTS operations.
- The III MEF lease of the Westpac Express showed cost and time savings for exercise movements in the Pacific Theater. Research should concentrate on further expansion of the savings that may be found in inter-theater logistics. Specifically, could HSFs provide cost savings in inter-theater movements in the Mediterranean Theater over current airlift assets?

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